Table 2
Coefficients results of the multiple linear regression models.

model	predictors	B	Beta	t	p
1	(constant)	6.008		9.526	<0.001
	WOMAC Stiffness	-0.012	-0.377	-2.842	0.007
	Knee extensor strength	-0.014	-0.229	-1.727	0.090
2	(constant)	1.100		-0.650	0.519
	WOMAC Stiffness	-0.001	-0.263	-2.176	0.034
	Age	-0.088	-0.444	3.678	0.001

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DIFFERENCES IN MULTI-JOINT SYMPTOMATIC OSTEOARTHRITIS PHENOTYPES BY RACE AND GENDER: THE JOHNSTON COUNTY OSTEOARTHRITIS PROJECT

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Purpose: We have identified differences in multi-joint patterns of radiographic osteoarthritis (rOA) by race and gender, and sought to determine whether similar differences were present for symptomatic osteoarthritis (sOA).
Methods: We used a subset of the Johnston County Osteoarthritis Project (data collected 2003-10) with complete symptom and radiographic data at multiple joint sites (n=1650, 36% men, 32% African American, mean age 66 ± 10 years, mean body mass index [BMI] 31 ± 6 kg/m2). Definitions of sOA were based on findings of both rOA (as defined in Table 1) and symptoms in the same joint site. Sixteen mutually exclusive phenotypes including all possible combinations of the 4 sOA variables were constructed, and Fisher exact tests with Hochberg correction for multiple comparisons were used to compare their frequencies by race and gender. Logistic regression with adjustment for race/gender, age, and BMI was performed for those phenotypes affecting at least 40 persons. Interactions between race and gender were considered noteworthy at p<0.2 and stratified analyses were performed as indicated.

Table 1. Definitions of Symptomatic OA*

Joint Site	Symptoms†	+	Radiographic OA criteria
Hand	hand	+	KL ≥2 in at least 1 DIP and at least 3 total hand joints
Knee	knee	+	Tibiofemoral KL≥ 2 or patellofemoral osteophyte ≥2‡ or joint replacement§
Hip	hip	+	Hip joint KL ≥2 or joint replacement§
Lumbosacral Spine	back	+	Disc narrowing and an osteophyte ≥1 at the same level (L1/2 to L5/S1)‡

*Symptomatic OA requires both symptoms and radiographic criteria in the same joint site, on the same side
†Answered yes to: "on MOST days do you have pain, aching, or stiffness of your ____?"
‡Osteophyte and disc narrowing graded 0-3 according to the Burnett atlas
§Joint replacement done for OA per participant
KL=Kellgren Lawrence grade, DIP=Distal InterPhalangeal joint

Results: Overall, the frequency of any sOA was as follows: hand 13%, hip 11%, knee 25%, and Lumbar Spine (LS) 28%. Compared to Caucasians, African Americans had less frequent Hand sOA, but more frequent Knee sOA (Table 2, left). After adjustment, African Americans had 70-80% lower odds of Hand sOA alone (aOR 0.19, 95% CI: 0.08-0.49) and the combination of Hand and Knee sOA (aOR 0.31, 95%CI: 0.13-0.76), but 80% higher odds of Knee sOA alone (aOR 1.78, 95% CI: 1.27-2.50).
Men were more likely to have no sOA in any site, and were less likely than women to have the combinations of Hand/Knee sOA or Hand/Knee/LS sOA (Table 2, right). After adjustment, men had 50-70% lower odds of Hand sOA alone or of Hand/Knee sOA in combination (Hand aOR 0.50, 95%CI: 0.27-0.91; Hand/Knee aOR 0.31, 95%CI: 0.13-0.75), but 50% higher odds of LS Only sOA (aOR 1.48, 95% CI: 1.09-2.01).

TABLE 2. Differences in multiple joint symptomatic osteoarthritis phenotypes by race and gender

Symptomatic OA Phenotype	Comparisons by Race: Caucasian n(%)	Comparisons by Race: African American n(%)	Comparisons by Race: Fisher exact p value†	Comparisons by Gender: Women n(%)	Comparisons by Gender: Men n(%)	Comparisons by Gender: Fisher exact p value†
No OA	544 (48.6)	292 (55.1)	*0.015*	**488 (46.4)**	**348 (58.1)**	***<0.001†***
Hand Only	**59 (5.3)**	**5 (0.9)**	***<0.001†***	50 (4.8)	14 (2.3)	*0.016*
Hip Only	33 (3.0)	12 (2.3)	*0.518*	25 (2.4)	20 (3.3)	*0.272*
Knee Only	**87 (7.8)**	**75 (14.2)**	***<0.001†***	115 (10.9)	47 (7.9)	*0.048*
LS Only	136 (12.1)	59 (11.1)	*0.569*	108 (10.3)	87 (14.5)	*0.011*
Hand/Hip	12 (1.1)	1 (0.2)	*0.073*	11 (1.1)	2 (0.3)	*0.151*
Hand/Knee	36 (3.2)	6 (1.1)	*0.011*	**36 (3.4)**	**6 (1.0)**	***0.002†***
Hand/LS	**38 (3.4)**	**4 (0.8)**	***0.001†***	34 (3.2)	8 (1.3)	*0.022*
Hip/Knee	20 (1.8)	6 (1.1)	*0.400*	12 (1.1)	14 (2.3)	*0.067*
Hip/LS	20 (1.8)	8 (1.5)	*0.839*	21 (2.0)	7 (1.2)	*0.239*
Knee/LS	50 (4.5)	38 (7.2)	*0.026*	60 (5.7)	28 (4.7)	*0.425*
Hand/Hip/Knee	6 (0.5)	0 (0)	*0.186*	5 (0.5)	1 (0.2)	*0.426*
Hand/Hip/LS	15 (1.3)	2 (0.4)	*0.113*	16 (1.5)	1 (0.2)	*0.009*
Hand/Knee/LS	28 (2.5)	4 (0.8)	*0.020*	**30 (2.9)**	**2 (0.3)**	***<0.001†***
Hip/Knee/LS	25 (2.2)	12 (2.3)	*1.000*	24 (2.3)	13 (2.2)	*1.000*
All sites	11 (1.0)	6 (1.0)	*0.797*	16 (1.5)	1 (0.2)	*0.009*
Total	1120 (100)	530 (100)	--	1051 (100)	599 (100)	--

*Mutually exclusive, referent is all other phenotypes
†***Significant*** *after Hochberg adjustment for multiple comparisons
LS=lumbosacral spine

Stratified analyses were performed for No sOA, Hand/LS sOA, and Knee/LS sOA due to race by gender interactions. Compared to Caucasian women, Caucasian men and African American men and women had 50-65% increased odds (aOR 1.48 to 1.65) of having No sOA in any joint site. Again compared to Caucasian women, African American women had 93% lower odds (aOR 0.07, 95%CI: 0.01-0.51), and Caucasian men had 73% lower odds (aOR 0.27, 95%CI: 0.10-0.70) of having a combination of Hand and LS sOA. For the combination of Knee and LS sOA, African American women had nearly twice the odds compared to Caucasian women (aOR 1.92, 95%CI: 1.12-3.29), with no significant differences for the men.
Conclusions: Consistent with our results looking at rOA phenotypes by race, African American individuals have lower frequencies of sOA of the hands, alone and in combination, but higher frequencies of knee sOA, compared to Caucasians. Compared to women, men are less likely to have sOA of the hands alone or in combination, but more likely to have isolated LS involvement.

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THE ASSOCIATION BETWEEN HAMSTRING STRENGTH AND HAMSTRING-QUADRICEPS STRENGTH RATIO WITH PATELLOFEMORAL JOINT CARTILAGE DAMAGE: THE MOST STUDY

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Purpose: It is known that quadriceps weakness is associated with patellofemoral joint (PFJ) structural damage. Recent in vitro biomechanical data suggests that hamstring loading increases joint stress on lateral PFJ cartilage, but this has not been linked to structural damage in vivo. The purpose of this study was to determine the association between hamstring strength and hamstring-quadriceps strength ratio (HQR), independent of quadriceps strength, with structural features of PFJ osteoarthritis (OA) on MRI.
Methods: The Multicenter Osteoarthritis (MOST) study is a prospective cohort study of individuals 60-79 years with or at risk for knee OA. Hamstrings and quadriceps strength were assessed using an isokinetic dynamometer and normalized per kilogram of body weight (Nm/kg). Cartilage damage on MRI was assessed by two musculoskeletal radiologists using the Whole Organ Magnetic Resonance Imaging Score (WORMS) scale on the lateral patella and trochlea (distal anterior femur). Analyses were performed in two groups of knees; those without whole knee radiographic knee OA (ROA) at baseline (n=391) and those with whole knee ROA at baseline (n=520). In the no OA group we examined worsening of cartilage damage (any increase in WORMS score) over 30 months as a function of muscle strength at baseline and in the ROA group, we examined prevalent full-thickness cartilage damage and concurrent muscle strength We began by examining the relationship between quadriceps strength, hamstring

strength, and HQR using Pearson's correlation coefficients. We then examined the association between sex-specific tertiles of hamstring strength and HQR and cartilage damage using separate logistic regression models. All analyses were adjusted for age, sex, BMI. Additionally, to determine if the association between HQR and cartilage damage was independent of quadriceps strength, we also adjusted for quadriceps strength and stratified the HQR analyses by high/low quadriceps strength. We also tested different definitions of lateral PFJ cartilage damage using different WORMS thresholds.

Results: The mean age was 61.6 years, mean BMI 29.5, and 61% were female. Quadriceps strength and hamstring strength were found to be independent of HQR, r= -0.26 and 0.15, respectively. We found no association between hamstring strength and PFJ structural damage in either group of knees. Among knees without ROA at baseline, we found no relation of HQR with worsening of PFJ cartilage damage; limbs in highest tertile of HQR had 0.8 (95% CI 0.4, 1.8) times the odds of worsening cartilage damage over 30-months compared to those in the lowest (p for trend 0.60). However, among knees with ROA at baseline, knees in the highest tertile of HQR had 2.8 (95% CI 1.7, 4.4) times the odds of cartilage damage compared to those in the lowest (p for trend <0.0001). Results were consistent across different thresholds for WORMS cartilage damage and were similar when stratifying by high/low quadriceps strength.

Conclusions: Hamstring strength was not associated with lateral PFJ structural damage; however, knees with ROA at baseline and high HQRs had greater prevalence of lateral PFJ cartilage damage, suggesting that HQR is associated with lateral PFJ cartilage damage independent of quadriceps strength. Since there was no association of HQR with the risk of cartilage loss in knees without OA at baseline, our results suggest that high HQR does not cause cartilage loss and the strong association with prevalent PFJ cartilage damage suggests that HQR imbalance may be produced as a result of the OA disease process.

Knees without radiographic OA at baseline				
Hamstring/Quadriceps Strength Ratio (Sex-specific Tertiles)				
	Tertile 1	Tertile 2	Tertile 3 (high)	P for trend
	135	134	134	
HQR Range				
Male	0.13-0.59	0.60-.70	0.71-1.31	
Female	0.18-0.60	0.603-0.731	0.732-1.32	
Worsening of Cartilage Damage over 30 months				
% WORMS increase ≥0.5	15.91	23.85	14.73	
Crude OR (95% CI)	1.0 (reference)	1.9(0.9,3.7)	0.8(0.4, 1.8)	
*Adjusted OR (95% CI)	1.0 (reference)	2.0(1.0,4.2)	0.8(0.4, 1.8)	0.60
*Adjusted for age, sex, BMI, and quadriceps strength				
Knees with radiographic OA at baseline				
Hamstring/Quadriceps Strength Ratio (Sex-specific Tertiles)				
	Tertile 1	Tertile 2	Tertile 3 (high)	P for trend
	181	186	183	
HQR Range				
Male	0.17-0.61	0.62-0.72	0.73-1.65	
Female	0.11-0.59	0.60-0.75	0.76-2.6	
Full Thickness Cartilage Damage at Baseline				
% WORMS 2.5/5-6	24.31	24.19	48.09	
Crude OR (95% CI)	1.0 (reference)	1.0(0.6,1.6)	2.9(1.8,4.5)	
*Adjusted OR (95% CI)	1.0 (reference)	1.0(0.6,1.7)	2.8(1.7,4.4)	<0.0001
*Adjusted for age, sex, BMI, and quadriceps strength				

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CLINICAL RESULTS OF NEW HEMI-OPEN CLOSED WEDGE HIGH TIBIAL OSTEOTOMY FOR OSTEOARTHRITIS OF THE KNEE

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Purpose: We performed clinical and radiographic evaluation of patients with medial compartmental osteoarthritis of the knee who had undergone treatment with new hemi-open closed wedge high tibial osteotomy (hybrid HTO) followed by early full weight bearing. This surgical procedures is adopted for sever varus knee, young patients, medial compartmental osteoarthritis (OA) accompanied with patello-femoral OA. Hybrid HTO procedures are demonstrated and clinical results and radiographic analysis were performed.

Methods: Hybrid HTO was performed in 18 knees of 14 patients of an average age of 62 years (range 54-69) at the time of the operation. All patients were diagnosed as primary OA knees. We established an early ROM exercise and permitted partial weight bearing one week and full weight bearing walk two weeks after their osteotomy. The average follow-up period was 16 months (range 12 to 48 months). Clinical examinations of the knee joints in our patient cohort consisted of both subjective and objective parameters that were recorded and documented using the Japan Orthopaedic Association OA Knee Scoring System (JOA score) and Oxford score. These evaluations were carried out pre-surgically and at the time of follow-up. Additional clinical findings that were assessed included range of motion, and possible post-surgical complications. Radiological evaluations were carried out on the femorotibial angle (FTA), using an AP weight bearing radiograph of a single leg, with the knee joint in extension. A weight bearing line (WBL) ratio was calculated using standing long-cassette radiographs of the lower extremities.

Results: The JOA Score and Oxford score showed significant improvement from 62±5.3, 38±10 points to 90±5.3, 16±3.5 points, respectively. Extension of the knee improved from -9.6±7.5° to -0.7±2.7°, and flexion changed from 130±11° to 128±8.7°. Prior to surgery, the average femorotibial angle during standing was 188±3.3° (8° anatomical varus) but measured 169±2.1° (11° valgus) at the time of follow-up. There were no instances of non-union or implant failure in any of our patient subjects. Their average WBL ratio was -7.5±15.5%, indicating that the WBL had shifted toward the medial compartment. After surgery, the the WBL ratio shifted to 71±8.5%, indicating that the WBL had moved toward the lateral compartment of the knee.

Conclusions: We contrived new operation procedure of closed wedge HTO and obtained good results clinically and radiographicaly. All patients could full weight bearing walk at two weeks after surgery. This procedure is adapted for patients who are relatively young and have high activity. Overall, this procedure can make shortening of the length of a leg the minimum. Hybrid HTO is a highly successfully course of treatment for correcting sever knee malalignment in patients with medial compartmental OA of the knee.

Figure 1